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(Final Draft)

Abstract

This paper analyzes productivity levels, dispersion and growth in the Bolivian Manufacturing Sector during the Market Liberalization Period: 1988-2001. These years are characterized first, by a period of macroeconomic stabilization and 1st Generation Reforms (1988-1993), second, by a period of privatization and 2nd Generation Reforms (1994-1997) and third, by a Post-reforms period (1998-2001). The 1st and 2nd Generation Reforms were framed in line with the Washington Consensus and their main objectives were to guarantee macroeconomic stability, to improve the efficiency and allocation of resources in the economy and to promote economic growth with fairness. We show that in contrast to what was expected, productivity in the manufacturing sector decreased steadily. We compute Total Factor Productivity (TFP), for the first time, using firm-level data and in addition we break down this measure in productivity per se and resource misallocation. We find that both issues contributed to the decline in productivity and if resource misallocation were eliminated, the gains in productivity would have been in the order of 60 percent, but the trend of productivity along time would have been the same, which means that there are also structural problems that affect productivity in Bolivia. In addition, we evaluate TFP considering exporting firms, size of firms, age of firms and geographical location.

Keywords: TFP, Market Structure, Manufacturing.

JEL Classification: D24, L1, L6.

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Contents

I. Introduction

The Manufacturing Industry is the economic activity with a major participation in Bolivia's GDP. In the 1990's it averaged 17 percent of GDP, employed 18 percent of the urban population and contributed 31 percent to the total value of exports. However, in comparison with other Latin American countries, the Bolivian industry's share with respect to GDP was one of the lowest. Most countries' Manufacturing Industry shares of GDP were over 30 percent.

In the 70's and until the beginning of the 80's, the industry was characterized by a high level of protection by means of high tariffs, quantitative restrictions, participation of large public companies that operated in captive markets, industries adapted to the internal market financed in their majority by national development banks and generalized subsidies. Until the middle of the 80's, Bolivia's development model was based on a State Capitalism where the State participated directly in the manufacturing activities.

Since August 1985, due to the application of the "New Economic Policy (NEP)" several changes took place in Bolivia and in particular in the manufacturing sector, from which we emphasize: the financial and commercial liberalization, the reduction of fiscal resources for technology, less institutional support for industries, stimulus for the internal and external competition, elimination of subsidies and the foresight of the privatization process of public enterprises. This new view favored an increased role for markets and the private sector in the economy with the corresponding withdrawal of the State's direct involvement in producing goods and services. In this period the informal sector also expanded due to an increase in the rate of unemployment brought about by the Stabilization Plan.

In the 90's the privatization of public enterprises took place. Garrón et.al. (2003) characterize the Bolivian privatization process in two modalities and three waves. The two modalities were traditional or standard privatization, and capitalization. The three waves, associated with three different governments, refer to periods in which a push was given to the privatization effort. The first wave started in 1992 with the enactment of the Privatization Law. The second wave, which introduced "Capitalization", the Bolivian bred scheme of transferring firms to the private sector, began in 1995. Finally, the third wave, which again privatized State Owned Enterprises in a standard fashion, started in 1998.

The NEP was also part of a broader structural adjustment program aimed at changing the whole function of the economy by reducing the influence of the state on production, increasing

reliance on the price system in the different markets (goods, labor and capital), and promoting private sector initiatives. As Jemio (2001) indicates, the framework of incentives adopted under the NEP included free convertibility of foreign exchange, elimination of price controls, reduced government intervention in labor contracts, financial liberalization and commitment to price stability. All these actions were designed to encourage greater private sector participation in the economy and to increase productivity in the industrial sector.

In summary, the period of 1988-2001 is a period where the development strategy of the Bolivian economy evolved from an inward examination, based on excessive state interventionism, towards an outward looking orientation, with more reliance on markets as resource allocation mechanisms and exports as the growth engine. In this paper, we analyze in detail if all the transformations that occurred in the period of market liberalization had an impact on productivity dynamics in Bolivia. The results show that they were unsuccessful in improving the productivity in the manufacturing sector. Contrary to the expectations involved with the reforms, productivity, measured as Total Factor Productivity (TFP), showed an annual accumulative rate of growth of -9.3 percent in the whole period.

To analyze the reforms in detail, we separate the whole period in three sub-periods. The first period goes from 1988 to 1993 which is the stabilization period and where all the 1st Generation reforms, above mentioned, were reinforced. The second period goes from 1994 to 1997 where new reforms (2nd Generation Reforms) were implemented. These reforms include: the program of capitalization of state enterprises, the reform of the pension system, an education sector reform and an administrative reform of decentralization of public expenditure programs through the "popular participation" and "decentralization" laws. The third period goes from 1998 to 2001 and we call it the Post reforms period which is characterized by the beginning of the crisis in part as reflection of the Brazilian crisis first and then the Argentinean crisis.[1]

One contribution of the paper and stressed by the new literature on productivity analysis (see Hopenhayn and Neumeyer (2008)) is that one important explanation for the productivity gap in Bolivia is resource misallocation. Aggregate TFP is affected both by the underlying distribution of firms' productivities and the allocation of resources, i.e. capital and labor across firms. So, misallocation of capital and labor arises as a result of distortions (market or policy

[1] In fact, in Bolivia the crisis reached its peak in 2003 and it was not only an economic crisis, but also a severe social crisis.

distortions). We show that by removing those distortions, the gains in productivity would have been on average in the order of 60 percent for the whole period and in comparison with the US these relative gains would have been 11.5 percent on average.

Besides documenting the level, dispersion and growth of total factor productivity (TFP) across formal firms and industries in the period 1988-2001, we analyze productivity differences among exporting and non-exporting firms. We study also if productivity depends on geographical location, for instance, if firms located in La Paz, Cochabamba and Santa Cruz are more productive than those located in other Departments. We show that productivity is significantly different among large, medium, small and micro firms, and finally we analyze the relation between productivity and age of the firm. The results of a multiple regression confirm that the main characteristic that explains the distribution of productivity across firms is the size of the firm, where large firms tend to be more productive. The analysis also shows that misallocation of capital and labor is independent of any characteristics of the firms.

We undertake this productivity documentation study using the unique firm-level data set available in Bolivia, which is the Annual Manufacturing Survey, implemented by the National Institute of Statistics (INE) between the years 1988-2001. This survey is a complete panel data of Bolivian formal firms. We apply the same methodology used by Hsieh and Klenow (2008) to make inferences about the degree of factor market and product market distortions, both at the industry and manufacturing levels. This methodology allows us to generate summary statistics that are comparable with other country studies and in particular with U.S which is our benchmark country.

The rest of the paper proceeds as follows. In section II we present a brief literature review covering all the studies that analyze productivity in the manufacturing sector in Bolivia. In section III we describe the policies and reforms that could account for the level and evolution of distortions. Section IV describes the empirical implementation of the Hsieh and Klenow (2008) model (data and descriptive statistics). In section V we show the evolution of TFP, we quantify the drag or boost in productivity due to misallocation of resources (productivity gains) and we analyze some particular issues related to productivity in Bolivia. Finally, section VI provides the conclusions.

II. Literature Review on Productivity in Bolivia

This section presents a brief literature review on productivity analysis in Bolivia. We want to stress that productivity per se has been rarely analyzed in Bolivia under a macro perspective and in particular under a micro perspective. In fact, most of the literature concentrates in analyzing the industrialization process through a sectorial perspective, but it does not penetrate into a firm analysis. Certainly, most of the studies were aimed in searching the appropriate industrial policy for the permanently desired industrialization process.

Machicado (1986) using data from the National Accounts and the Input-Output Matrix evaluates the different industrial sectors and proposes an alternative policy to accelerate the industrialization development. Cobas (1987) develops a study for the implementation of a strategy for the industrial development. The study was part of an agreement of the Inter American Development Bank with the Bolivian Government and covers the most detailed explanation of the sectorial structure of the Bolivian industry.

In the 1990's the Bolivian authors began to use econometric techniques to analyze industrial issues, employing aggregated data by industrial sectors (at 2, 3 and 4 digits of ISIC). Valverde (1994) estimates a production function for the manufacturing sector using energy inputs instead of the traditional capital and labor inputs. He employs a simple OLS regression and although he finds important relations between output and energy usage, he concludes that a production function based on capital and labor inputs could explain better and provide more elements to analyze industrialization and to formulate policy recommendations. Antelo (1995), using data from the Private System of Industrial Information, analyzes market structures, competitiveness and industrialization constraints as credit constraints, regulation and external markets, for industrial and agro-industrial branches at 2 and 4 digits of ISIC.

Antelo and Dorado (1996) employ a multivariate analysis and a factorial analysis to study the microeconomic factors that affect the development of the industrial sector in Bolivia. They use the Annual Manufacturing Survey for the periods 1988-1992 using also aggregated information by economic activity. Chavez and Dorado (1996) and Muriel (1999) employ univariate analysis using the Physical Volume Index (IVF). The first authors model the stochastic process of this series under transitory and permanent shocks, while the second author decomposes the series in its cyclical and trend components.

Recently, in the 2000's as part of the evaluations of the economic reforms implemented in the 1990's, some papers appear that analyze productivity. A nice review of productivity issues can be found in Jemio and Antelo (2000) where there are special chapters devoted to the analysis of productivity in telecommunications industry, the electric energy industry, the hydrocarbons industry and the agricultural sector. It is of particular importance for the present study the chapter 7 of that book, where the relation between reforms, growth, technical progress and employment is analyzed.

The first work that uses firm-level data in Bolivia is the paper of Jiménez and Landa (2004). They evaluate the labor performance of small and mid sized firms between 1995 and 1999 and present the basic elements that explain the dynamic of the labor market and the constraints for labor creation in Bolivia. In addition they estimate the coefficients of the factors of production from a basic production function. They also estimate a demand function for non-qualified workers. Their main conclusion is that the employment creation depends heavily on the economic expansion of firms that already operate in the market, and on new investments, but conditional on the levels of productivity and efficiency in the usage of factors.

Finally, in 2006, under the initiative of "Maestrias para el Desarrollo" of the Bolivian Catholic University and with the support of the Foundation for Production (FUNDAPRO), a research program was launched to develop a productive vision for Bolivia, with the intention to include it in the new Constitution. From this program, the papers of Perez de Rada (2006) and Nina and Von Vacano (2006) are highlighted. In particular, the latter constitutes a comparative study with other countries where labor productivity is analyzed by industry, by size and by export markets.

Although the work by Jiménez and Landa (2004) use firm-level data and compute TFP using a frontier production function, they do not analyze in deep the issue of total factor productivity in Bolivia. They just perform this calculation as an extension of their labor analysis. In addition, the other works employ aggregated data by economic activity and do not analyze multifactor productivity. Therefore the study that we propose will be the first of its type in analyzing total factor productivity in detail.[2]

[2] There are many descriptive publications about the industrial sector and industrial policy in Bolivia. See, for example Escobar de Pabón and Kruse (2002) and Lazo (2005). A detailed review can be found also in Machicado (2006).

III. Structural Reforms in Bolivia

According to Antelo (2000), the structural reforms implemented in Bolivia were framed in line with the Washington Consensus and aimed to guarantee macroeconomic stability, to improve the efficiency and allocation of resources in the economy and to promote economic growth with fairness. Among the various reforms the highlights were the commercial and financial reforms, public sector reforms, the labor market reforms and the incorporation of the environment as a key variable in the design and formulation of governmental policies. The main objective of these reforms was to boost a sustainable development of the country.

The seed of these reforms was the stabilization policy implemented since 1985 with the enactment of the D.S. 21060 and became known as the New Economic Policy (NPE for its initials in Spanish). The NPE had two basic objectives: i) to stabilize prices eliminating the hyperinflation in order to build up the base for an economic recovery with sustainable growth and ii) to restore the external solvency from a development model based in the market forces to allocate resources in the economy, and the openness of the country.

The following table based on Barja (2000) summarizes the structural reforms, the economic policy and other events that characterized the hereafter called the market liberalization period in Bolivia.

Table 1: Periods of the Structural Reforms

1986-1989 Economic Stabilization and 1st Generation Reforms	1989-1993 Deepening of the 1st Generation Reforms	1993-1997 2nd Generation Reforms	1998-2001 Post Reforms
-Exchange rate alignment -Commercial policies in favor of exports -Liberalization of interest rates and the financial market -Liberalization of the markets of consumption goods. -Independence of monetary policy -Price liberalization -Tax reform -Reduction and control of public expenditures -Foreign debt negotiations	-Investment Law in favor of foreign investment -Privatization Law and first wave of privatizations -SAFCO Law seeking efficiency in the public sector -Education reform and the start of long-run social policies -New Tax Code -New Mining Code -ESAF accord with the IMF	-Capitalization Law and second wave of privatizations -SIRESE Law and Laws of Telecom, Electricity and Hydrocarbons -Creation of the regulatory institutions (Superintendencies). -Pensions Law -INRA Law to promote the land reorganization -Decentralization Law -Popular Participation Law -Constitutional Reform	-Third wave of privatizations

Source: Barja (2000)

Escobar de Pabón and Kruse (2002) characterize Bolivia as a "precocious reformer". Since 1985, with the application of the structural adjustment, Bolivia promoted and consolidated

a free market economy. It followed rigorously the guidelines for achieving monetary and fiscal policy discipline and, at the same time, implemented various reforms oriented to the liberalization of the goods, services, and financial markets and to the privatization of the state owned enterprises (SOEs).

As a result, Bolivia showed up as one of the more open economies in Latin America, according to the World Organization of Commerce and, it is stressed that this openness was first the result of anticipated reforms and independent initiatives of the Bolivian government and not necessarily the result of bilateral or multilateral treaties, as it occurred in other countries.

The main elements of these reforms that affected directly the manufacturing sector include:

• The application of uniform tariffs of 10 percent with very few exceptions, and insignificant non-tariff barriers.

• Absence of controls to the access of the national markets, among them the use of quotas for imports and tariff levels.

• Licenses for imports applicable to few products, and preference margins for government purchases in favor of national enterprises up to 10 percent.

• Lack of antidumping measures as safeguard actions for industries.

• Elimination of significant subsidies to the agriculture.

• New national and sectorial legislation for investments. This legislation liberalized all the sectors, facilitating (or practically forcing) the Foreign Direct Investment (FDI) in the sectors.

• The legislation on FDI established the "national treatment" and other measures of protection and legal security for investors.

• No discriminatory policies between sectors. All policies, to stimulate the manufacturing production, were the same for all sectors.

• The reform of the tax system into a plain and efficient structure. Before 1985, there were around 120 taxes with excessive complexity. After 1987 the tax system included only 6 taxes with an understandable structure.[3]

As it can be seen, a series of national laws were enacted to create a robust protection for investors. The angular stone was certainly the Law of Investments of 1990, complemented with sectorial legislations like the new Code of Mining, the Law of Electricity, the Law of

[3] See Otalora (2009)

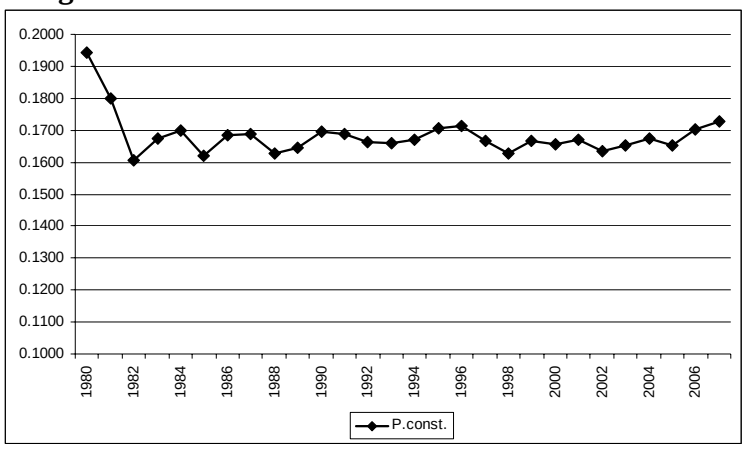
Telecommunications, and the Hydrocarbon Law, among others. These laws established the "national treatment", that is to say that all company independent of its origin must receive the same treatment and ample guarantees for the exercise of its property rights.

This law eliminated also all restrictions to the entrance and exit of capital and to the remission of dividends to other countries. Cheap credit (at low interest rates) and exemptions were removed; there were ample guarantees for the free convertibility of the currency, as well as for the free import and export of goods and services, and for the free determination of prices. All kind of production and commercialization activities (legally of course) were unrestrained and operations of risk sharing (joint ventures) were protected.

III.1. Industrial Structure in Bolivia during 1988-2001

To evaluate the impact of the market liberalization reforms on productivity, first we have to describe the manufacturing sector. During the period of 1988 - 2001 the manufacturing industry shows a stable behavior in relation to its participation in the productive structure of the country. The share of the manufacturing sector of GDP was 16.68 percent, on average, with a standard deviation of 0.0026 percentage points. Only in years 1995 and 1996, this share has been over 17 percent, these years correspond to the period of 2nd Generation Reforms.

Figure 1: Share of Industrial GDP in Bolivia's GDP



Source: INE

In table 2, we present some comparative economic indicators of the manufacturing industry. There is a sustainable fall in the household consumption of industrial products over total household consumption. This consumption falls from 49.07 percent in 1988 to 45.69 percent in 2001. We cannot affirm that the final demand of industrial products of national origin has been replaced by imports, because they do not show a sustainable increase throughout the

period. In fact, imports show an irregular behavior, increasing between 1988 and 1992 and also between 1996 and 1998, but decreasing in other periods.[4]

Table 2: Comparative Economic Indicators of the Manufacturing Industry, 1988-2001 (in percentage)

YEARS	GDPi/GDPt	IMPORi/IMPORt	HOUS.CONi/HOUS.CONt	FBKFi/FBKFt	EXPi/EXPt
1988	0.1628	0.8299	0.4907	0.3970	0.2259
1989	0.1647	0.8391	0.4889	0.3545	0.2894
1990	0.1696	0.8416	0.4871	0.4131	0.3348
1991	0.1689	0.8487	0.4837	0.4801	0.3532
1992	0.1663	0.8513	0.4802	0.4874	0.3658
1993	0.1660	0.8250	0.4717	0.4721	0.3623
1994	0.1672	0.8193	0.4752	0.4144	0.3931
1995	0.1706	0.8250	0.4792	0.4509	0.3796
1996	0.1714	0.8473	0.4772	0.4648	0.4137
1997	0.1666	0.8568	0.4694	0.4797	0.4079
1998	0.1626	0.8659	0.4612	0.3923	0.4653
1999	0.1666	0.8247	0.4589	0.3818	0.5003
2000	0.1654	0.8556	0.4597	0.3498	0.5129
2001	0.1671	0.8342	0.4569	0.3332	0.5127
Mean	**0.1668**	**0.8403**	**0.4743**	**0.4194**	**0.3941**
Stand. Dev.	**0.0026**	**0.0144**	**0.0116**	**0.0533**	**0.0839**

Source: Author's calculations

Observe also that the ratio Gross Formation of Fixed Capital (FBKF for its initials in Spanish) experienced an important growth during the years 1991 and 1992, falls towards 1994, recovers towards 1997, but then it falls even below the levels at the beginning of the period, which indicates that investment in the manufacturing industry decreased in the post-reform period, in particular in 2000 and 2001. In contrast, exports' share displays a sustainable increase, from 22.59 percent to 51.27 percent. This is a direct result of the policy of the exports' promotion that started in 1987 with the enactment of the D.S. 21660 and the Law 843 (Tax Reform). The aim of these measures was to introduce some mechanisms to guarantee the "tax neutrality" by allowing the return of indirect taxes paid by exporters of non-traditional goods, for instance. In 1990 the "Procedures for Temporary Admission for Exports (RITEX)" is also created. With this regime, exporters could import raw materials and intermediate goods with the goal to produce export goods, without having to pay taxes and tariffs.

These and other measures to promote exports became consolidated with the enactment of the Law 1489 in 1993. With this law, exports and imports were fully liberalized, as well as access to international financing, and to any type of services that exporting firms considered

[4] Cobas (1987) shows a clear negative relation between the ratios of household consumption and imports, during the period 1980-1986.

necessary. Bolivia established also new bilateral and multilateral Commercial Agreements, seeking access to international markets with preferential conditions.[5]

III.2. Rates of Growth of the Economy and the Manufacturing Sector

The three periods identified are clearly distinct in terms of growth in the economy. The 2nd Generation Reform's period (1994-1997) is clearly the one with the greatest rate of growth. The rate of accumulated annual growth was of 4.66 percent, as it is shown in table 3. Other variables as the household consumption, government consumption and the FBKF show the largest growth rates in this period. In fact the internal demand grew 6.35 percent. In contrast, exports display the lowest rate of growth (3.59 percent) and imports grew over 10 percent.

Table 3: Rates of Accumulated Annual Growth (in percentages)

Periods	GDP	Final Consumption			Gross Formation of Fixed Capital			Internal Demand	Exports	Imports	X-M
		Hous.	Gov.	Total	FBKF	VE	Total				
2001/1988	0.0367	0.0319	0.0292	0.0315	0.0449	(0.0064)	0.0409	0.0328	0.0676	0.0469	(0.1396)
1993/1988	0.0391	0.0307	0.0206	0.0293	0.0880	(1.6487)	0.0633	0.0340	0.0960	0.0632	(0.0820)
1997/1994	0.0466	0.0387	0.0418	0.0392	0.1725	(2.1993)	0.2022	0.0635	0.0359	0.1011	(2.9719)
2001/1998	0.0154	0.0211	0.0272	0.0219	(0.1536)	0.0211	(0.1468)	(0.0109)	0.0282	(0.0627)	(0.6087)

Source: Author's calculations

In the period of 2nd Generation Reforms, the rate of growth of investment of 20.22 percent is noteworthy, surpassing the moderate growth during the deepening of the 1st Generation Reforms' period (6.33 percent) and the growth in the whole period (4.09 percent). Although investment experienced this important rate of growth, in the Post-reforms' period, it decreased by -14.68 percent. In general, all variables were depressed in their growth in the sub-period of Post-reforms. The GDP hardly grew by 1.54 percent, the internal demand decreased by -1.09 percent and imports fell by -6.27 percent, while exports only grew by 2.82 percent. In synthesis we can say that this sub-period shows an economy entering a period of crisis that would reach its worst level in the year 2003.[6]

In the 1st Generation Reforms' period the rate of growth of exports (9.6 percent) is remarkable. Again this is the result of the market liberalization, free convertibility of the exchange rate, the elimination of all kind of price controls and the opening to the external commerce. However, we have to mention that Bolivian exports remain concentrated in few products related to natural resources or agricultural products, with emphasis on soy bean and its

[5] See Candia (1999)

[6] Note that in the rest of the study we call the period of the deepening of the reforms as the 1st Generation Reforms period only for simplicity.

derivatives, zinc, silver, gold, tin, natural gas, woods and golden jewelry, which made exports still very vulnerable to fluctuations of international prices of commodities.

The government consumption had its greater growth during the 2nd Generation Reforms' period also as a result mainly of the implementation of the Pensions' System Reform. Bolivia passed from a pay-as-you-go system to a fully-funded system. It influenced also the process of Administrative Decentralization that implied a decentralization of the government expenditure programs towards the regions, in particular municipalities (Law of Popular Participation and the Law of Decentralization).

In general, throughout the period of analysis, the economy had a moderate growth of 3.67 percent. It could even be considered low, if we think that a poor country like Bolivia needs rates of growth larger than 6 percent to reduce poverty. Only exports surpassed this rate of 6 percent. Apparently, the market liberalization period had been successful only in this issue and for few selected companies.

The unfolding of the Manufacturing Industry during the three stages of reference is very similar to what occurred in the economy as a whole. In the following table it can be seen that the rates of accumulated annual growth of the industrial GDP were slightly superior to those of the economy but they can also be considered low. In the whole period the industrial GDP grew only by 3.88 percent.

Table 4: Rates of Accumulated Annual Growth in the Manufacturing Industry (in percentages)

Periods	Manufact. GDP	Final Consumption			Gross Formation of Fixed Capital			Internal Demand	Exports (FOB)	Imports (CIF)	X-M
		Hous.	Gob.	Total	FBKF	VE	Total				
2001/1988	0.0388	0.0262	0	0.0262	0.0309	(2.1441)	0.0493	0.0290	0.1371	0.0473	(0.0070)
1993/1988	0.0432	0.0226	0	0.0226	0.1264	0.2533	0.1178	0.0345	0.2045	0.0620	0.0081
1997/1994	0.0454	0.0345	0	0.0345	0.2311	(2.2926)	0.3391	0.0816	0.0487	0.1176	0.1770
2001/1998	0.0247	0.0179	0	0.0179	(0.1985)	(0.0731)	(0.1825)	(0.0219)	0.0620	(0.0742)	(0.1936)

Source: Author's calculations

Note that in the whole period the government did not acquire consumer goods from the manufacturing industry. In fact one of the basic supports of the NPE was an austere fiscal policy. This adjustment based in the rationalization of the government expenditures eliminated all type of acquisitions from the industrial sector. This practice which was common during the import substitution period and the State's capitalism, introduced several distortions because most of these acquisitions were made from selected firms and with subsidized prices.

The sub-period of 2nd Generation Reforms is characterized by an increase in household consumption of 3.45 percent, as well as of imports of 11.76 percent. In this period the investment in the manufacturing sector experienced also an important rate of growth of 33.91 percent which lead to a rate of growth of the internal demand of 8.16 percent. In contrast, the sub-period of Post-reforms, already classified as the beginning of the crisis, shows a depressing manufacturing sector. Investment fell by -18.25 percent, which implies a decrease of the internal demand of -2.19 percent, even though household consumption increased slightly by 1.79 percent.

During the sub-period of 1st Generation Reforms we have to emphasize the high rate of growth of exports (20.45 percent). This rate is indeed also explained by the application of all the market liberalization reforms mentioned above. The FBKF experienced also an interesting growth of 12.64 percent. During the 2nd Generation Reforms, it grew at a 23.11 percent but in the Post Reforms period it decreased at a rate of -19.85 percent. Everything indicates that all the efforts made with the 1st and 2nd Generation Reforms did not have a solid base, since the main variables show an important decline at the end of the period of analysis.

III.3. Employment in the Manufacturing Industry

The manufacturing industry occupied the second place in terms of employment share in the urban areas of Bolivia, as it is seen in table 5. On average, during the period 1988-2001, it absorbed 17 percent of the employment, after the commerce sector that occupied 25 percent of the population. In third place appears the communal and personal services with 11.92 percent and the rest of the sectors, each occupy less than 10 percent of the population. This tendency has maintained also in the last years, so it can be considered the standard pattern of the Bolivian economy.

The years in which the manufacturing sector contributed with more employment were 1997 with 19.81 percent, 1992 with 19.59 percent and 1996 with 19.14 percent. In the 1st Generation Reforms' period there is a sustainable growth in employment, whereas the opposite happened in the Post-reforms' period, the employment share decreased down to 14.15 percent in 2001.

Table 5: Employment Share by Sectors, 1988-2001 (in percentages)

Economic Activity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1999	2000	2001
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Agriculture, Silviculture and Fishing	1.89	2.22	1.23	1.77	2.09	1.87	1.63	2.20	2.76	1.89	3.84	4.90	11.37
Mining Extraction	1.86	1.99	1.99	2.07	1.79	1.36	1.26	1.66	1.15	1.27	0.85	1.70	1.13
Manufacturing Industry	**12.91**	**14.08**	**15.92**	**18.08**	**19.59**	**18.30**	**18.18**	**18.21**	**19.14**	**19.81**	**18.37**	**15.30**	**14.15**
Production, Distribution of Gas and Water	0.47	0.83	0.61	0.75	0.75	0.41	0.45	0.40	0.53	0.63	0.27	0.80	0.52
Construction	6.54	7.80	6.62	8.55	9.29	8.15	9.68	8.48	7.96	8.87	8.75	10.40	7.66
Commerce (Gross and Retail)	24.30	22.50	22.32	24.90	25.23	25.73	27.23	27.69	26.84	24.37	26.89	25.40	24.31
Hotels and Restaurants	4.66	3.56	3.24	4.46	3.84	5.15	5.95	5.77	6.24	5.30	6.29	6.00	6.28
Transport, Storage and Communications	7.59	7.83	7.68	7.22	7.13	8.40	7.49	7.56	6.97	8.65	8.58	6.90	7.69
Financial Intermediation	1.01	0.85	1.14	0.97	0.81	1.24	1.08	1.06	1.14	1.27	0.87	1.00	0.93
Real State Activities and Services for Enterprises	1.72	1.45	1.85	2.76	3.12	3.16	2.93	2.83	3.05	3.65	3.56	4.60	4.72
Public Administration	6.50	7.21	7.09	5.81	5.70	5.28	4.82	4.53	5.25	4.44	3.90	3.50	3.01
Communal and Personal Services	19.49	17.88	18.88	11.76	10.44	10.39	9.13	9.92	10.08	9.05	7.25	10.80	9.93
Social Services, Education and Health	10.60	11.07	10.57	10.64	9.49	10.43	9.95	9.36	8.76	10.64	10.52	8.70	8.27
Extra territorial Organizations	0.46	0.74	0.86	0.27	0.72	0.14	0.23	0.33	0.12	0.15	0.06	0.10	0.03

Note: Year 1998 is not included because that year the INE did not implement any statistical activity for employment.
Source: INE, based on Household and Employment Surveys.

IV. Data

We employ data drawn from the Bolivian Annual Manufacturing Survey 1988-2001 (BAMS). The BAMS is an unbalanced panel of Bolivian formal firms. This survey was implemented every year and approximately 8 months after the bookkeeping period is finished. The information corresponds to the bookkeeping year of the firms (12 months) which starts on April 1st until March 30th, or January 1st until December 31st, thus the survey is based on the Bookkeeping Registries and Balance Sheets of the firms.

The institution in charge of its implementation is the National Institute of Statistics (INE). The survey started being implemented in the 70s as a survey to all kind of economic establishments (commerce, logistics facilities, construction, mining and manufacturing industry). However, from 1988 to 2001 the survey covered only the manufacturing industry[7].

The survey has a national coverage, it includes industrial establishments from the 9 Departments of Bolivia.[8] All large and medium firms from the sample universe are included. Large firms are categorized as the ones that have 50 and more employees, medium firms have between 15 to 49 employees. Small firms are a sample of small formal firms in the country. They are categorized as having between 5 to 14 employees. Micro firms are also included in the sample. This is because small firms that were included, later shrank to less than five workers.

The survey contains variables related to the value of production, sales, consumption of raw materials, electrical energy and fuels consumption, personnel occupied, payments and wages, taxes and fixed assets. Firms are classified by sectors according to four digits International Standard Industrial Classification (ISIC). In addition, as all establishments with more than 15 employees were included in the survey and firms with less than 15 employees were subject to random sampling, the survey is not based on a Census of firms. Establishments were added into the database just to have a representative picture of the sectorial structure of the manufacturing industry. Certainly, this issue does not exclude the possibility that some sectors can be under or over represented.[9]

To validate our data, in table 6 we present the number of firms and employment by size class in 1992. This data corresponds to the 2nd Census of Economic Establishments performed in Bolivia. Notice that micro and small firms (less than 15 workers) represent 90 percent of total firms and constitute 50 percent of total employment in the Manufacturing sector. Although large firms (more than 50 workers) constitute only 2 percent of total firms, they account for approximately 33 percent of employment.

[7] The INE stopped its implementation in 2001, but it implemented again in 2008. In this new version (not available yet) they included questions related to environment and the usage of information and communication technologies (ICT).

[8] Although it has a national coverage, it includes only 1 firm from the Department of Pando and few from the Department of Beni.

[9] The survey was stopped, because of lack of funds to continue implementing it. It seems that in 2000 and 2001 this problem lead to a reduction in the number of firms surveyed.

Table 6: Number of Firms and Employment by Size Class (1992)

	Firms				Employment			
Firm Size (number of employees)	**Number of Firms**	**Cumulative Total**	**Share of Total (%)**	**Cumulative Share (%)**	**Number of Workers**	**Cumulative Total**	**Share of Total (%)**	**Cumulative Share (%)**
1-4	10783	10783	75	75	22970	22970	30	30
5-9	1674	12457	12	87	10454	33424	14	44
10-14	388	12845	3	89	4564	37988	6	50
15-19	189	13034	1	91	3112	41100	4	54
20-24	132	13166	1	92	2887	43987	4	57
25-29	77	13243	1	92	2072	46059	3	60
30-39	94	13337	1	93	3147	49206	4	64
40-49	52	13389	0	93	2301	51507	3	67
50-99	111	13500	1	94	7556	59063	10	77
100 or more	81	13581	1	94	17655	76718	23	100
Missing	808	14389	6	100				

Source: INE-2nd Census of Economic Establishments

According to the data, it seems that the INE divided the whole period in two sub-periods. One sub-period goes from 1988 to 1994 and the other goes from 1995 to 2001. We noticed that division because first, firms in the data from 1988 to 1994 were classified according to ISIC revision 2 and firms in the data from 1995 to 2001 were classified according to ISIC revision 3. Second, although some firms appear in both sub-periods they were given different identification numbers. To merge the two data sets we had to identify firms by their names, commercial labels, address and even their numbers of Unique Registry of Contributors. In some cases we have also reassigned the ISIC numbers because they were not standardized.

IV.1. Descriptive Statistics

In the data base, we deleted all the firms that report negative and zero value added and also those firms that reported no employees and no fixed assets in some year. After deleting those firms we arrived to an average number of 770 firms per year. Table 7 summarizes the number of firms in each year.

In terms of employment, our data accounts for 35000 employees per year, on average. The maximum number of workers is reached in year 1998 with 43951 employees, while the minimum number of workers corresponds to year 1988 with 28347 employees. The following table shows the share of employment and value-added by size class, in average, for the whole period (1988-2001).

Table 7: Number of Firms in the Panel by Size

	Number of Workers							
Year	**1-4**	**5-9**	**10-19**	**20-49**	**50-99**	**100-249**	**250 or more**	**TOTAL**
1988	140	207	187	178	72	50	15	849
1989	169	197	170	171	83	49	18	857
1990	247	215	188	164	86	50	17	967
1991	105	111	138	157	81	59	18	669
1992	187	167	177	161	90	62	24	868
1993	107	199	157	165	94	52	32	806
1994	111	202	155	159	87	61	37	812
1995	86	185	168	134	71	56	27	727
1996	28	159	150	134	75	68	33	647
1997	68	202	168	130	77	68	30	743
1998	89	239	192	151	80	81	39	871
1999	134	204	190	132	83	64	42	849
2000	81	106	96	94	56	58	30	521
2001	98	120	106	121	59	65	26	595

Source: Author's calculations

Table 8: Employment and Value-Added covered by the Data (Average 1988-2001)

	Employment				Value Added			
Firm Size (number of employees)	**Number of Firms**	**Cumulative Total**	**Share of Total (%)**	**Cumulative Share (%)**	**Millions of Bs.**	**Cumulative Total**	**Share of Total (%)**	**Cumulative Share (%)**
1-4	346	346	1	1	7.62	7.62	0	0
5-9	1200	1547	3	4	23.22	30.84	1	1
10-19	2217	3764	6	11	61.00	91.84	2	3
20-49	4608	8372	13	24	230.13	321.97	7	10
50-99	5367	13738	15	39	236.93	558.91	7	18
100 or more	20913	34651	59	97	2573.26	3132.16	81	99

Source: INE

According to the 1992 Census, firms with more than 10 employees account for 56 percent of total employment in the manufacturing sector. In our data, these firms represent 95 percent of total employment and account for approximately 99 percent of total value added (output) in the industry. These percentages indicate that our data is not a good representation of small firms. Nevertheless, the fact that 99 percent of total value added is covered by firms with more than 10 employees, allows us to remove those firms with less than 10 workers for our baseline calculations.[10]

[10] Results do not change when we add the smaller firms.

V. Productivity Dynamics in Bolivia

To document resource misallocation and productivity in Bolivia's manufacturing industry, we employ the model developed by Hsieh and Klenow (2008) (hereafter HK08). It is a standard model of monopolistic competition with heterogeneous firms that shows how distortions that drive wedges between the marginal products of capital and labor across firms lower aggregate Total Factor Productivity (TFP). All the details of the model's derivation can be found in appendix 1.

In the last years, TFP has been analyzed by the macro literature emphasizing the analysis of gaps and recently this analysis has turned to the microstructure of productivity and its implications for aggregate TFP. Hopenhayn and Neumeyer (2008) state that aggregate TFP is affected both by the underlying distribution of establishments' productivities and the allocation of resources –e.g. capital and labor- across these units. In this behalf, in this section we compute the size and distribution of wedges that explain aggregate TFP in Bolivia, using the BAMS survey.[11]

For our calculations we computed the Gross Production Value and Intermediate Consumption to obtain the Value-Added, which is our measure of output. We have information on the number of workers as well as on their remunerations. Therefore, we have used wage payments, bonus payments and benefits for our measure of labor compensation. Finally, we employed the value of fixed assets as our capital measure. All of the variables are firm-level variables and the industries are classified according to 4 digit ISIC (ISIC-4) classification.

For our baseline calculations that excludes firms with less than 10 employees, we employed the same values used by HK08 for the rental price of capital R and the elasticity of substitution between firm value added σ, i.e, R=0.10 and σ=3. In appendix 3, we perform a sensitivity analysis using a value of σ=5, to verify if efficiency gains in Bolivia are sensitive to the curvature parameter as Hopenhayn and Neumeyer (2008) demonstrate.

We also set the elasticity of output with respect to capital in each industry (α_s) to be one minus the labor share in the corresponding industry in the U.S. To construct the shares we used the NBER data and defined labor share as labor compensation over value-added. We took the

[11] For the analysis of gaps see Klenow and Rodriguez-Claré (1997), Hall and Jones (1999) and Hsieh (2002). For the microstructure see Bartelsman and Dom (2001) and Foster, Haltiwanger and Krizan (2001) and (2002).

average over all the years of the data after matching the U.S. codes to the relevant codes for Bolivia. Also as a robustness check we performed our calculations using the labor shares from Bolivia and industry shares from US.[12]

Then, based on these parameter values and the firm data, we infer the wedges and firm specific productivities using the following equations:

$$1+\tau_{Ksi} = \frac{\alpha_s}{1-\alpha_s}\frac{wL_{si}}{RK_{si}} \qquad (1)$$

$$1+\tau_{Ysi} = \frac{\sigma}{\sigma-1}\frac{wL_{si}}{(1-\alpha_s)P_{si}Y_{si}} \qquad (2)$$

$$A_{si} = \kappa_s \frac{(P_{si}Y_{si})^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s}(wL_{si})^{1-\alpha_s}} \qquad (3)$$

Equations (1) and (2) enable us to infer the presence of capital and output distortions respectively. In equation (3) we compute TFPQ (our measure of physical productivity) and we have to mention two things about the scalar κ_s. First, the scalar $\kappa_s = w^{1-\alpha_s}(P_sY_s)^{\frac{1}{\sigma-1}}/P_s$ is not observable, because we do not have industry prices for all the sectors. However, even though we do not observe κ_s, relative productivities – and hence reallocation gains – are unaffected by setting κ_s =1 for each industry *s*. Second, κ_s varies not only across industries, but also across time. Following Tybout (2008) it would have been ideal to adjust TFPQ by this scalar to account for cyclical fluctuations, but as we mentioned, we do not have prices for all the sectors. Thus, we have just used the overall industry price index to adjust our measure of TFP in order to make comparisons between years.

Before calculating the gains from our hypothetical liberalization, as HK08, we omitted the 1 percent tails of $\log(A_{si}/adj \times \overline{A}_s)$, where $adj = (1/M_s)^{1/(\sigma-1)}$, and $\log(TFPR_{si}/\overline{TFPR}_s)$ across industries. That is, we pooled all industries and omitted the top and the bottom 1 percent of firms within each of the pools in order to eliminate outliers. We then recalculated wL_s, K_s and P_sY_s as well as $\overline{TFPR}_s$ and $\overline{A}_s$. We also calculated the Bolivian industry shares $\theta_s = P_sY_s/PY$.

[12] See the results in appendix 3.

V.1. Aggregate TFP and Reallocation Gains

Through frontier estimations of production functions, Jimenez and Landa (2004) conclude that there is a clear lack of technical efficiency among firms in Bolivia. In other words, firms obtain levels of output under their possibilities of production. We show that this inefficiency can be attributed to a decline in productivity among firms. The next table presents the evolution of aggregate TFP in the Bolivian manufacturing sector for the period 1988-2001. It displays the evolution of actual TFP and also the evolution of potential TFP which is the TFP that would have arisen in the absence of distortions.[13]

Table 9: Evolution of Aggregate TFP (in percentages)

Period	TFP	TFP^{eff}
88-01	-9.3	-15.8
88-93	-2.7	-12.7
94-97	-30.8	-36.2
98-01	-38.5	-41.6

Source: Author's calculations
Note: TFP^{eff} refers to potential TFP

It can be seen first, that variations of potential TFP are higher than variations of actual TFP, while actual TFP decreases by -9.3 percent in the whole period, potential TFP decreases by -15.8 percent. Second, actual TFP decreases at an increasing rate in each of our selected sub-periods. In the 1st Generations Reform period TFP decreases only by -2.7 percent. In the 2nd Generations Reform period, it decreases by -30.8 percent and in the Post-reforms period, it decreases by -38.5 percent. In general, the persistent decline in TFP shows that the intention to promote productivity with the market liberalization reforms remained as an intention. Actual and potential TFP decreased not only in the Post Reforms period where we have seen that investment decreased a lot, but also in the 1st and 2nd Generation Reforms periods where investments in the manufacturing industry increased and exports boosted.

In the model of appendix 3 we show that TFPR (our measure of revenue productivity) is related to the ratio of distortions. Therefore, as in HK08 we perform the same "liberalization" exercise by computing the TFP gains from reallocation, i.e. the gains of removing the efficiency loss introduced by the output and capital distortions or in other words by fully equalizing TFPR

[13] TFP for each sector is computed as in equation (A.22) of the model in appendix 1 and aggregated using our Cobb Douglas aggregator in equation (A.1). TFP^{*} is equation (A.22) but with the ratio $\overline{TFPR}_s / TFPR_{si}$ equal to 1.

across firms in each industry. The ratio of actual TFP to the efficient TFP is computed according to the following equation and the gains are displayed in table 10.

$$\frac{TFP_s}{TFP_s^{eff}} = \prod_{s=1}^{S}\left[\sum_{i=1}^{M_s}\left\{\frac{A_{si}}{\overline{A}_s}\frac{\overline{TFPR}_s}{TFPR_{si}}\right\}^{\sigma-1}\right]^{\frac{\theta_s}{\sigma-1}} \qquad (4)$$

Table 10: TFP Gains from Equalizing TFPR within Industries (in percentages)

ISIC-4	(TFPeff/TFP)-1						
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
TFP gains	52.5	55.8	56.7	55.4	59.7	57	62.3
Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
TFP gains	53.5	60.8	65.5	70.6	59.2	59.8	60.6

Source: Author's calculations

The elimination of distortions (τ_k and τ_y) would boost aggregate manufacturing TFP by around 59.3 percent, on average, in the whole period. In the stabilization and the 2nd Generation Reforms periods the elimination of distortions would raise TFP by 56.2 percent and 60.6 percent respectively, while in the post reforms period it would raise TFP by 62.6 percent. The year in which full liberalization would have the major impact would be 1998 with an increase in TFP by 70.6 percent while in 1988 would be the year with the least impact, of only 52.5 percent.

Allocation gains are low compared to the gains found for India and China, by HK08, which are about 100 percent, but the Bolivian gains are higher than the gains found for the US which are between 31-43 percent. Notice also that the gains increase as time passes which means that allocative efficiency declined during the 2nd Generations Reform period and obviously during the Post Reforms period.

Bolivia is situated, in terms of allocative inefficiency, between the US and India-China. Table 11 below shows the efficiency loss introduced by the output and capital wedges in comparison to US in 1997 as reported in HK08. It is seen that on average the TFP gains relative to the U.S, are in the order of 11.5 percent. For Bolivia, hypothetically moving to "U.S. efficiency" in 1997 might have boosted TFP by 9.3 percent and 12.4 percent in the 1st and 2nd Generation Reforms periods respectively.

Table 11: TFP Gains of Equalizing TFPR relative to U.S. in 1997 (in percentages)

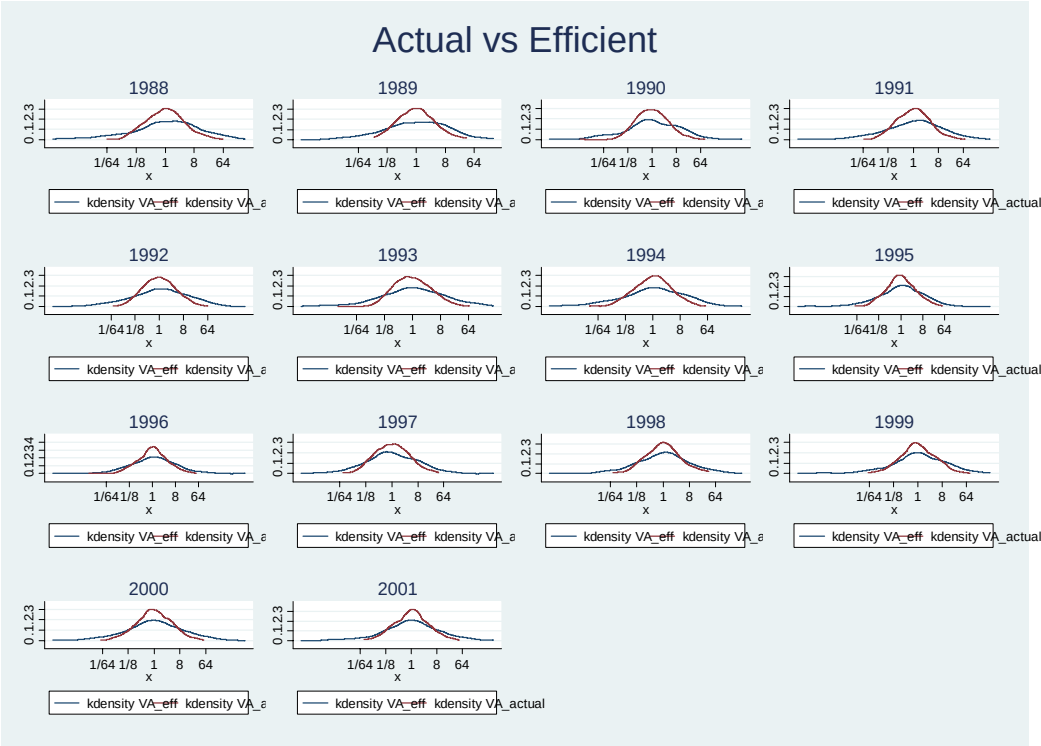
ISIC-4	(TFPeff/TFP)-1						
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
TFP gains	6.7	9	9.7	8.7	11.7	9.9	13.6
Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
TFP gains	7.4	12.6	15.8	19.4	11.4	11.7	12.4

Source: Author's calculations

The initial conclusion of this section is that Bolivian allocative efficiency declined by about -5 percent from 1988 to 2001 or -0.4 percent per year. This implied decline in allocative efficiency is surprising given that many reforms took place in this period. Considering that TFP growth decreased by -9.3 percent between 1988 and 2001, the implied decline in allocative efficiency explains around 4 percent of TFP negative growth or in other words 4 percent of TFP decline could be attributed to a worst allocation of capital and labor across firms.

Figure 2 plots the "efficient" vs. actual size distribution of plants in each year. Size is measured as firm value added. Notice that in all the years the hypothetical efficient distribution is more dispersed than the actual one. This means that in the Bolivian manufacturing industry, there should be fewer mid-sized firms and more small and large firms or small and large firms should produce more than what they are actually producing.

Figure 2: Distribution of Firm Size



Source: Author's calculations

In table 12 we display how the size of initially big vs. small firms would change if TFPR were equalized in Bolivia and the U.S. in year 1997. The rows are initial (actual) plant size quartiles, and the columns are bins of efficient plant size relative to actual size: 0-50% (the plant should shrink by a half or more), 50-100%, 100-200%, and 200+% (the plant should at least double in size).

Table 12: Percentage of Firms, Actual Size vs. Efficient Size in Bolivia and U.S. (1997)
Size measured as Value Added

1997	0-50%	50-100%	100-200%	200+%
		Bolivia		
Top Size Quartile	3.9	6.5	7.4	7.2
2nd Quartile	4.1	6.3	9.8	4.8
3rd Quartile	2.8	8.3	10.4	3.5
Bottom Quartile	2.1	5.7	13.3	3.7
		U.S.		
Top Size Quartile	4.4	10.0	6.7	3.9
2nd Quartile	4.4	9.6	5.8	5.1
3rd Quartile	4.5	9.8	5.4	5.4
Bottom Quartile	4.7	12.0	4.3	4.1

Source: Author's calculations

In Bolivia there is a clear dominance of the third column while in the US the dominance appears in the second column. These results indicate that the majority of the Bolivian firms in each quartile should double their size. In contrast, the US firms in each quartile should decrease by less than a half.

We also performed the same exercise as in table 12, but now defining size as the number of workers in each firm. In the table below it is seen again that in all of the firms considered, they nned to increase the number of workers, in fact they should double the number of workers, in order to improve efficiency.[14]

Table 13: Percentage of Firms' Actual Size vs. Efficient Size in Bolivia (1995)
Size measured as Number of Employees

1995	0-50%	50-100%	100-200%	200+%
Number of workers				
10-19	4.48	8.30	15.02	8.97
20-49	5.16	6.95	10.54	6.73
50-99	1.35	4.48	7.17	2.24
100-249	1.79	2.24	7.62	0.90
250+	0.45	1.12	4.26	0.22

Source: Author's calculations

One of the weakest issues of the reforms performed in Bolivia and with an important impact over the manufacturing industry is certainly the labor legislation. Jemio (2000) states, that the labor legislation, the regulations and the government intervention have created rigidities and distortions in the labor market and in the business practices. The General Law of Labor in Bolivia that is still in effect today, was approved in 1939 and upgraded to a rank of law in 1942.

[14] Tables 12 and 13 for each year are available upon request from the authors. In general the results are very similar in each year.

The first regulations were enacted in 1943 and since then there have been lots of modifications, exceptions and amplifications to the law with the sole consequence of complicating the interpretation and application of the law.

First, the law promotes uncertainty, for instance in 1982 there were 500 laws and 2500 regulations affecting directly or indirectly the law. Second, the labor legislation and the social legislation have significantly increased the labor costs. Labor costs are affected by the minimum wage, government pressures over the private sector, taxes, bonus payments, overtime, payment for night work and for holydays, sick leave, compensations, among other payments. The reaction of the employers to these regulations has been, first to evade most of these payments (informality or pseudo informality) and second, to employ less workers than what they actually needed.

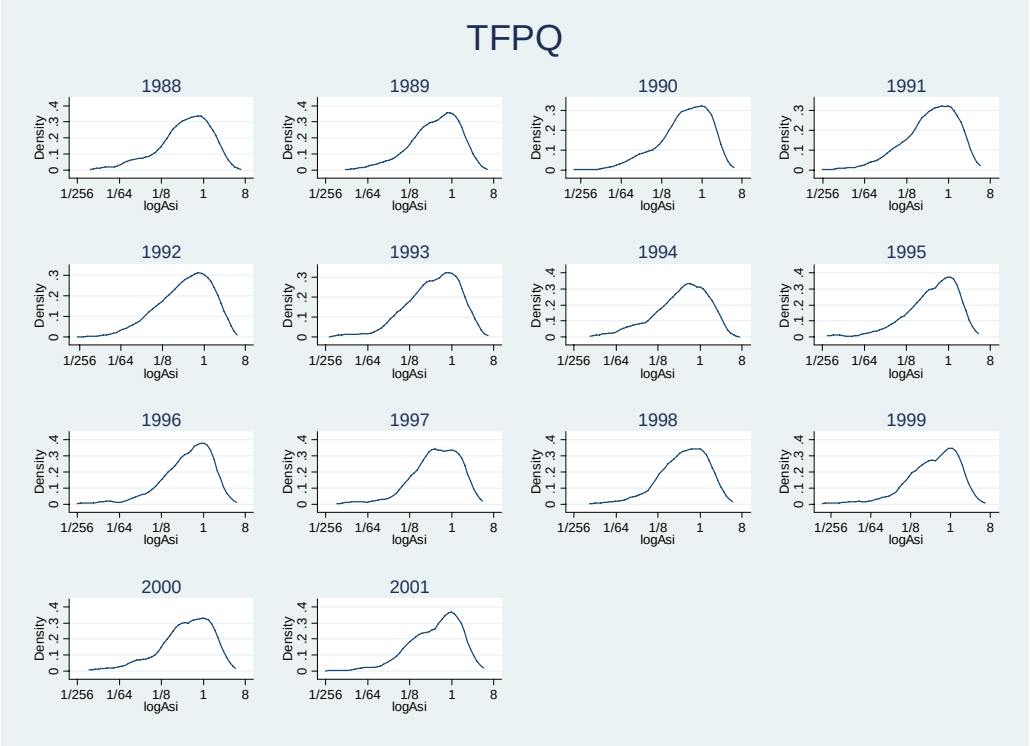
V.2. Physical and Revenue Productivity in Bolivia

To understand TFP levels and growth during the market liberalization period in Bolivia, it is important to analyze the distribution of our physical productivity measure (TFPQ) and revenue productivity measure (TFPR) as well as the distribution of the output and capital distortions.[15]

Remember that it is not only the level, but also the dispersion of TFPQ and TFPR that will affect aggregate productivity in the economy. In figures 3 and 4, we plot the distribution of TFPQ and TFPR for all firms in the sample for each year as a log-deviation from industry specific means. Notice that TFPQ is more dispersed and shifted to the right, while TFPR is less dispersed and displays a more regular figure, similar to a normal distribution, with a mean around 1.

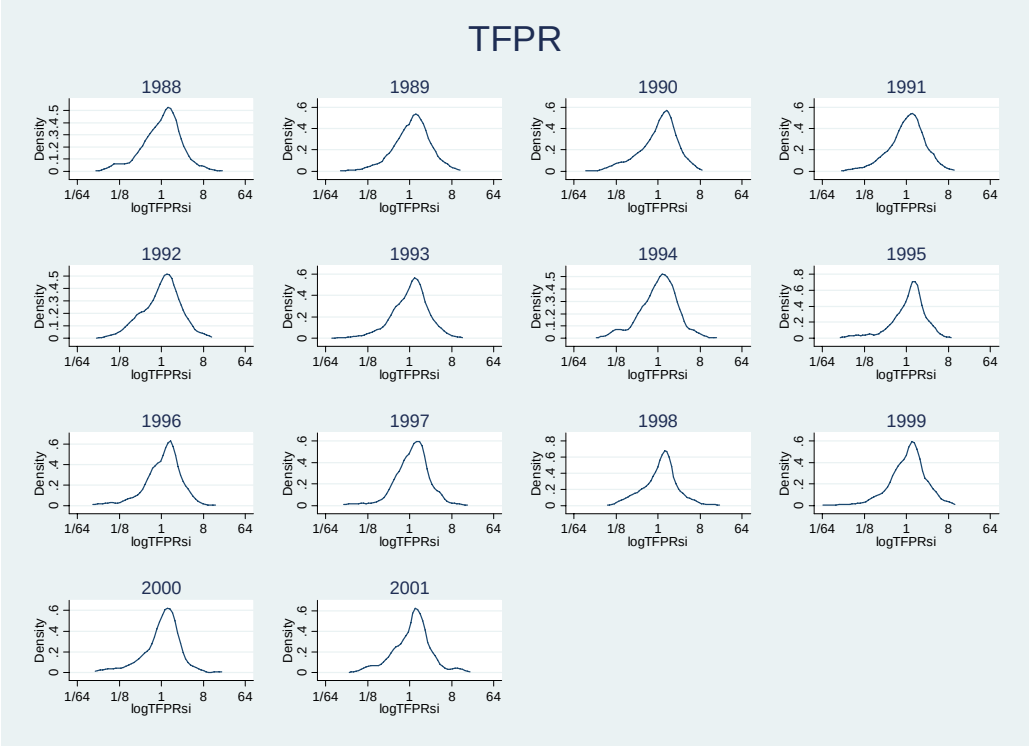
[15] In equations (A.20) and (A.23) of appendix 1, TFPR is defined for firms and sectors.

Figure 3: Distribution of TFPQ



Source: Author's calculations

Figure 4: Distribution of TFPR



Source: Author's calculations

In table 14 we show several measures of dispersion for TFPQ and TFPR: the standard deviation, the 75th minus the 25th percentiles, the 90th minus the 10th percentiles and the 50th minus the 10th percentiles.

Table 14: Dispersion of TFPQ and TFPR

TFPQ														
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Sd	1.25	1.15	1.27	1.26	1.28	1.25	1.26	1.21	1.19	1.13	1.12	1.29	1.25	1.20
p75_p25	1.57	1.54	1.72	1.69	1.76	1.65	1.69	1.50	1.43	1.50	1.50	1.62	1.54	1.71
p90_p10	3.26	2.90	3.31	3.14	3.30	3.16	3.37	2.91	2.82	2.77	2.74	2.92	3.31	2.94
p50_p10	2.04	1.73	2.07	1.92	2.01	1.78	2.09	1.80	1.74	1.58	1.55	1.73	2.10	1.85
TFPR														
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Sd	0.91	0.86	0.90	0.86	0.90	0.88	0.88	0.84	0.83	0.80	0.81	0.86	0.86	0.88
p75_p25	1.06	1.00	1.05	1.00	1.13	1.03	1.06	0.83	0.95	0.91	0.88	0.93	0.91	0.97
p90_p10	2.16	2.09	2.23	2.15	2.38	2.09	2.07	1.98	1.99	1.86	2.07	2.08	1.96	2.06
p50_p10	1.27	1.19	1.43	1.18	1.38	1.21	1.18	1.24	1.18	1.03	1.24	1.18	1.25	1.26

Source: Author's calculations

Standard deviation for TFPQ is on average 1.22 which is larger than what HK08 found for China and the U.S. in any of the years, but is similar to the standard deviation found for India in the year 1994. The difference of the 90th percentile and the 10th percentile is, as in India, above 3 in most of the years. The largest difference occurs in 1994 with a value of 3.37, while the lowest difference occurs in 1998 with a value of 2.74.

Dispersion of TFPR has been on average 0.86. In the year 1994 it was higher than in India (0.67), and in 1997 it was higher also than in the U.S (0.49). The difference of the 75th percentile minus the 25th percentile ranges from 0.83 to 1.13. This range is above the ranges found for India (0.79-0.81) and the US (0.46-0.53) by HK08. Only China displays similar differences, in fact it ranges from 0.82 to 0.97. The numbers in the table are consistent with greater distortions in Bolivia than in India and the U.S. but with similar distortions as China.

In table 15 we show the same dispersion measures as in table 14, but for the wedges. In any year the standard deviation of τ_K is higher than the standard deviation of τ_Y. The standard deviation of τ_K decreases from 1.07 in 1988 to 0.94 in 1993 which corresponds exactly to our 1st Generation Reforms period. It increases in 1997 up to 0.97 and in 1998 and 2001 it reports a standard deviation of 1. The standard deviation of the output distortion τ_K shows a more irregular pattern although it decreases if we compare the beginning and the end of the period. It decreases from 0.76 to 0.62.

Table 15: Dispersion of the Wedges τ_K and τ_Y

						τ_K								
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Sd	1.07	1.05	0.99	0.88	0.96	0.94	0.98	0.97	0.95	0.97	1.00	0.93	0.86	1.00
p75_p25	1.27	1.13	1.11	1.07	1.17	1.06	1.24	1.16	1.19	1.03	1.14	0.97	0.94	1.02
p90_p10	2.65	2.51	2.46	2.14	2.39	2.30	2.40	2.35	2.29	2.43	2.29	2.38	2.19	2.22
p50_p10	1.14	1.03	1.10	0.99	1.05	1.00	1.10	1.07	1.09	1.00	1.01	0.98	0.88	0.77
						τ_Y								
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Sd	0.76	0.60	0.74	0.75	0.75	0.71	0.77	0.66	0.67	0.58	0.64	0.69	0.67	0.62
p75_p25	0.85	0.74	0.83	0.78	0.82	0.78	0.79	0.64	0.66	0.61	0.72	0.75	0.73	0.67
p90_p10	1.70	1.46	1.80	1.79	1.83	1.75	1.84	1.55	1.53	1.38	1.46	1.56	1.70	1.53
p50_p10	0.77	0.69	0.79	0.81	0.86	0.85	0.91	0.66	0.72	0.61	0.74	0.67	0.79	0.61

Source: Author's calculations

The patterns described by the statistics in tables 14 and 15 are complemented by scatter plots of the log of TFPQ relative to the industry mean and the log of TFPR, the output distortion and the capital distortion also relative to their industry means. The plots are in appendix 2 and show a negative correlation between TFPQ and the output distortion. There is a positive correlation between TFPQ and the capital distortion and also there is a positive and strong correlation between TFPQ and TFPR.

Table 16: Regressing log (TFPR) on log (TFPQ)

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
logAsi	0.5885***	0.5877***	0.5492***	0.5716***	0.5892***	0.5491***	0.5701***
	[0.0264]	[0.0289]	[0.0522]	[0.0136]	[0.0195]	[0.0422]	[0.0213]
Constant	0.5585***	0.5904***	0.5244***	0.5265***	0.5617***	0.5302***	0.5463***
	[0.0329]	[0.0345]	[0.0525]	[0.0271]	[0.0230]	[0.0425]	[0.0220]
Observations	489	479	489	441	497	484	482
R-squared	0.701	0.663	0.703	0.752	0.723	0.702	0.715
Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
logAsi	0.5480***	0.5582***	0.5347***	0.5414***	0.5377***	0.5707***	0.5475***
	[0.0325]	[0.0474]	[0.0416]	[0.0272]	[0.0227]	[0.0595]	[0.0424]
Constant	0.5234***	0.5216***	0.5501***	0.5676***	0.5390***	0.5183***	0.5726***
	[0.0281]	[0.0311]	[0.0350]	[0.0297]	[0.0341]	[0.0382]	[0.0453]
Observations	446	447	460	528	484	325	357
R-squared	0.669	0.680	0.620	0.609	0.676	0.674	0.607

Source: Author's calculations

Note: *** if significative at 1%; ** if significative at 5%; * if significative at 10%

HK08 state that efficiency is linked to not only dispersion in TFPR but also its covariance with TFPQ. Hitting higher TFPQ firms with bigger distortions (higher TFPR) is particularly damaging to aggregate TFP. Table 16 presents the regressions of log(TFPR) on log(TFPQ). Notice that the elasticities are positive and significative at 1 percent level in all the years.

Moreover, the coefficients are always above 0.5 which means that in all of the years they are larger in Bolivia than in India, China or the U.S. This result suggests efficient firms may face more restrictions in Bolivia than in other of the three countries.

V.3. Bolivian Features and TFP

In this section we test some common beliefs related to productivity for the Bolivian case by performing some basic regressions using TFPQ and TFPR as our dependent variables. Specifically we analyze the relation between TPFQ and TFPR with exporting firms, size (where size is measured as the number of employees) age and geographical location. As our sample is small, in this section we present the results using the whole sample, i.e. including firms with less than 10 employees. This fact guarantees also the significance of the coefficients in the regressions; otherwise results would have to be taken with caution as we were including a few observations.

First, we analyze TFPQ and TFPR in exporting and non-exporting firms. In Table 17 we show the results of regressing the log of TFPQ and TFPR (relative to industry means) on a dummy that represents exporting firms. Regressions are weighted least squares with industry value added shares as weights for the years 1990, 1995 and 2000 as representative years for our three reform periods.

Table 17: Productivity for Exporters (vs. Non-exporters)

	TFPQ		
Years	**1990**	**1995**	**2000**
Export	0.1578*	0.1153***	0.0042
	[0.0884]	[0.0391]	[0.0415]
	TFPR		
Export	-0.0638	0.0620**	-0.0520
	[0.0680]	[0.0257]	[0.0446]

Source: Author's calculations

Note: *** if significative at 1%; ** if significative at 5%; * if significative at 10%

Notice, that exporting firms had 16 percent higher TFPQ in 1990 than non-exporting firms. This advantage decreased in 1995 to 11 percent and less than 1 percent in 2000. The fact that the coefficient in year 2000 in not statistically significant implies also that this 0.4 percent higher TFPQ is not meaningful and exporters and non-exporters have the same productivity. In comparison with the US, TFPQ differences are much lower in Bolivia, in US TFPQ is 121 percent higher on average for exporting firms. The main difference is that in USA exports are

concentrated in many firms while in Bolivia exports are concentrated in only a few firms. In the year 2000, almost three-fourths of total exported products came out from hardly 10 companies and more than 83 percent came out from only 20 companies. In Bolivia, it is typical to observe, even today, a shift towards a greater concentration of the exported value in few companies.

If we consider TFPR, the results indicate that although exporting firms reported lower TFPR in 1990 and 2000, these differences are not statistically significant. In 1995, exporting firms display a 6.2 percent higher TFPR and this difference is statistically significant at the 5 percent level. Recall from equation (A.21) in the model, that TFPR is related to the ratio of distortions $(1+\tau_K)^{\alpha}/(1-\tau_Y)$ so we can interpret TFPR as the level of distortions. In this behalf we can see that in year 1995 exporting firms suffered a higher level of distortions, which can be related to the higher level of formality under which they usually operate.

In sum exporting firms are more productive than non-exporting firms, but this advantage decreased during the reforms period, in opposition to what was expected. Bernard and Jensen (2001) document, based in previous works, that exporters have higher productivity along with more workers, higher wages, greater capital intensity, higher technology intensity, and are more likely to be part of a multi-plant firm. The results confirm that during the 1st and 2nd Generation Reforms periods, exporters had higher productivity, but faced the same distortions as non-exporters. The fact that exporting firms are very few in each of the years explains the declining pattern of aggregate TFP. Although exporting firms are more productive and as we have seen in section III, their exports grew in each of the periods, they cannot compensate for the decline in aggregate TFP. In 1988, exporting firms represented only 12 percent, while in 1995 they represented 20 percent of total firms.

The commercial liberalization that took place promoted an effective openness and integration of Bolivia with the external commerce, but it did not increase the competitiveness and productivity of the tradable sector in a sustainable manner.

Next, we analyze if there are differences in TFPQ and TFPR among large, medium, small and micro firms in Bolivia. Recall that this size division considers the number of employees per firm. Table 18 shows the results of the corresponding regressions for the years 1990, 1995 and 2000.

As in the previous regressions, the dependent variable is the deviation of log TFPQ and TFPR from the industry mean. The independent variables are dummies for medium, small and

micro firms. The omitted coefficient is for micro firms. As expected, productivity is positively correlated with size. Large firms tend to be more productive than medium sized firms and medium sized firms tend to be marginally more productive than small firms. Only in the year 1995, there are no differences in TFPQ among small and micro firms. In sum, large firms are the most productive of all and differences in productivity are sizable and became larger. In 1990, large firms had a 178 percent higher TFPQ than micro firms, while in 2000 large firms had a 216 percent higher TFPQ.

Table 18: Productivity by Size

	TFPQ		
Year	**1990**	**1995**	**2000**
Small	0.6071***	0.2475	0.5775**
	[0.1822]	[0.2932]	[0.2449]
Medium	1.0782***	0.8403***	1.3212***
	[0.1766]	[0.2565]	[0.2930]
Large	1.7887***	1.6368***	2.1632***
	[0.2249]	[0.3430]	[0.2746]
	TFPR		
Small	0.0839	-0.1674	0.0531
	[0.1137]	[0.1871]	[0.1798]
Medium	-0.1742	-0.3049**	-0.2081
	[0.1353]	[0.1496]	[0.2041]
Large	-0.0920	-0.2089	-0.0289
	[0.1800]	[0.1997]	[0.1789]

Source: Author's calculations
Note: *** if significative at 1%; ** if significative at 5%; * if significative at 10%

An interesting result comes out from analyzing TFPR differences. Differences between large, medium and micro firms are statistically not significant, with the exception of medium firms in the year 1995. In this year, medium firms have 30 percent lower TFPR than micro firms, which means that they faced smaller distortions. The results point out that all type of firms face the same level of distortions. How can be that small firms face the same distortions as large firms? Following Lazear (2000), we think that labor flexibility among all kind of firms can be part of the explanation. This fact allows small firms to be hit from fewer distortions. Further more, the higher level of informality among small firms and pseudo informality among medium and even large firms explain the equal level of distortions under which firms operate in Bolivia.[16]

[16] See Birbuet and Machicado (2009) for an interesting case study among formal and informal firms in the shoe-leather sector.

We conclude that there is a direct relation between TFPQ and size. TFPQ decreases with the size of the firm, large firms are the most productive, while micro firms are the least productive. But TFPR did not have a direct relation with size.

Next, in table 19, we analyze the relation between productivity and age of the firms. Hopenhayn and Neumeyer (2008) consider that firm's age might be an important covariate to consider when analyzing TFPR. One of the reasons for this is, for instance, that borrowing constraints are less likely to affect older firms, because as time goes by firms might be able to extent their reach and access more markets and/or government purchases and tap into resources of better neighbors. We have classified younger firms as those firms that are less than 5 years old, medium age firms as those that are between 6 and 10 years old and, old firms as those that are more than 11 years old.

Table 19: Productivity by Age

	TFPQ		
Year	**1990**	**1995**	**2000**
Between 5 and 10	0.1867	-0.1745	-0.6106
	[0.2704]	[0.1797]	[0.3865]
More than 11	0.4719*	0.0544	0.0518
	[0.2364]	[0.1503]	[0.3162]
	TFPR		
Between 5 and 10	-0.0345	-0.0869	-0.4875
	[0.1538]	[0.1156]	[0.3919]
More than 11	-0.0950	-0.2682*	-0.3819
	[0.1000]	[0.1360]	[0.2844]

Source: Author's calculations
Note: *** if significative at 1%; ** if significative at 5%; * if significative at 10%

According to the table, there are no differences in TFPQ, nor in TFPR between firms of different ages. Only in 1990, older firms are 47 percent more productive (TFPQ) than the industry averages and in 1995 they have 26 percent lower TFPR than the industry averages. However these differences are significant only at a 10 percent level.

Not shown in the table, only in the years 1988 and 1989 we find that older firms are more productive in terms of TFPQ than younger firms and these differences are statistically significant at a 1 percent level. In terms of TFPR we didn't find important differences in the whole period. These results confirm our hypothesis that most of the distortions that prevailed in Bolivia at the beginning of the 80's if they were not removed, they have been homogenized due to the implementation of the NEP. For instance, the NEP liberalized the financial markets and

facilitated the build up of a microfinance system that gave access to credit, not only to small firms, but also to young and informal firms.[17]

Finally, we present the regressions of TFPQ and TFPR against all the firm characteristics considered already and including also a dummy that refers to the region where firms are located. This is particularly important for Bolivia, since it is a country that presents huge differences between the three main Departments which are La Paz, Cochabamba and Santa Cruz and the rest of the Departments. The three main Departments are called the Axis. Considering solely the infrastructure, these three Departments offer a far better infrastructure than the others, for the manufacturing industries, although it is still considered deficient compared with other Latin American countries. Therefore we divided firms located in the central axis (the three Departments mentioned above) and those located in the rest of the Departments.[18]

Table 20: TFPQ and TFPR with Multiple Covariates

	TFPQ			TFPR		
Year	**1990**	**1995**	**2000**	**1990**	**1995**	**2000**
Small	0.5589***	-0.0312	1.5730**	0.0516	-0.3139**	0.6142
	[0.2019]	[0.2221]	[0.6531]	[0.1326]	[0.1486]	[0.5920]
Medium	1.0931***	0.6245**	2.0960***	-0.1620	-0.3775***	0.1282
	[0.1816]	[0.2364]	[0.6648]	[0.1511]	[0.1381]	[0.4371]
Large	1.7719***	1.4994***	2.6061***	-0.0395	-0.1992	0.0622
	[0.2108]	[0.2954]	[0.6138]	[0.1908]	[0.1800]	[0.4436]
Between 5 and 10	0.0661	-0.2567	0.6561**	-0.0148	-0.0757	0.2738
	[0.2373]	[0.1700]	[0.3176]	[0.1473]	[0.1153]	[0.2778]
More than 11	0.0568	-0.4538***	1.4838***	-0.0638	-0.2703**	0.9496***
	[0.1983]	[0.1603]	[0.1445]	[0.1099]	[0.1294]	[0.1770]
Export	0.1454	-0.0181	-0.0805	-0.0224	-0.1312	0.1740
	[0.2240]	[0.1474]	[0.2117]	[0.1369]	[0.1213]	[0.2206]
Out of the Axis	-0.3604**	-0.3321**	-0.2690	-0.1246	-0.0215	0.2072
	[0.1593]	[0.1616]	[0.3401]	[0.1105]	[0.1324]	[0.3401]
Constant	-2.0475***	-1.2818***	-3.9581***	0.1265	0.5498***	-0.9522**
	[0.2374]	[0.2436]	[0.5725]	[0.1541]	[0.1551]	[0.4253]

Source: Author's calculations
Note: *** if significative at 1%; ** if significative at 5%; * if significative at 10%

From the table above we can extract our main conclusions of this section. First, it is clear that the main characteristic that explains productivity differences in Bolivia is the size of the firm. Large firms are undoubtedly more productive in terms of TFPQ. If a firm exports or not

[17] Bolivia is considered nowadays a leading country in microfinance in Latin America, and is exporting its know-how to other countries. (See IDB News: http://www.iadb.org/NEWS/detail.cfm?language=English&id=4570).
[18] The other Departments are: Oruro, Potosi, Tarija, Chuquisaca, Beni and Pando.

does not seem to influence productivity. Note that if a firm is not located in the main Departments it has a lower TFPQ, although in year 2000, the coefficient is not statistically significant. The coefficients for age show mixed results. In year 1990 older firms are as productive as younger firms, in 1995 they are less productive an in 2000 they are more productive.

Second, looking at the columns for TFPR, it can be seen that apparently only the age of the firm can explain TFPR differences, but again the results change. For instance, in the year 1995 older firms had lower TFPR which means they faced smaller distortions, but in the year 2000 they display higher TFPR, which means that they face higher distortions. Also in the year 1995, medium firms faced smaller distortions. Nevertheless, in general we can conclude that distortions are independent of the firm's characteristics, i.e. the market liberalization period and its reforms homogenized distortions for all kind of firms.

V.4. Productivity, Output, Employment and Relative Prices

Finally in this section we want to relate the manufacturing sector analysis of section III with our productivity analysis. In particular, we want to see if the process of external openness and the structural reforms have contributed to a change in relative prices within the manufacturing industry and if these changes have affected the investment, production and employment decisions. The analysis is aggregated for the manufacturing sector, based on results by sectors.[19]

We have included only those sectors for which we had production price indexes and those sectors for which we had information in all the years. In total we have included 29 sectors which are indeed the most representative of the manufacturing industry in Bolivia. For instance we have production of meat products, manufacture of grain mill products, manufacture of textiles, manufacture of furniture, among others. With the objective mentioned above we analyze the correlation between the following variables for the different sectors and averaged for the manufacturing industry.

- Output
- Employment
- TFP
- TFPQ

[19] We leave for another study the analysis of each of the sectors.

- TFPR
- Real wages
- Relative prices (production prices relative to the industry mean)

Table 21 displays the correlation matrix of the annual rates of growth of the aforementioned variables. The correlations are average values for the different sectors of the industry. Jemio (2000) shows a similar matrix, but using the labor productivity as measure of productivity and computes the correlations for the years 1987 to 1997.

Table 21: Correlation Matrix of the Variables

	Output	Employment	TFP	TFPQ	TFPR	Real Wages	Relative Prices
Output	1.00						
Employment	0.51	1.00					
TFP	0.70	0.27	1.00				
TFPQ	0.64	0.27	0.97	1.00			
TFPR	0.34	0.02	0.85	0.87	1.00		
Real Wages	0.63	0.76	0.33	0.31	-0.10	1.00	
Relative Prices	-0.15	0.02	-0.09	-0.08	-0.10	0.04	1.00

Source: Author's calculations

Note that there is a positive correlation between output variation and TFP variation. The coefficient of 0.7 indicates that changes in production are highly correlated with changes in productivity. The correlation with TFPQ is slightly smaller (0.64) and the correlation with TFPR indicates that changes in output are positively correlated with changes in the level of distortions but not as much as with changes in productivity per se.

The correlations between variation in output and variations in employment and real wages are 0.51 and 0.63 respectively. These correlations are much higher than those found by Jemio (2000) which were 0.26 and 0.27 respectively. There is also a positive correlation between changes in employment and changes in productivity but the coefficient is low (0.27) this means that increases in productivity are slightly related to increases in employment. Increases in productivity (TFP) are translated also slightly into increases in real wages (0.33)

We find negative correlations between variations in our three measures of productivity and variations in relative prices. Nevertheless, the correlations are not significative. The same occurs between variations in relative prices and variations in output. Observe a positive and high correlation between variations in employment and in real wages (0.76) which indicates that changes in real wages have influenced significantly the levels of employment. In fact real wages represent an important proportion of production costs.

Lastly, to reinforce our conclusion that there is a positive correlation between output and our measures of physical (TFPQ) and revenue productivity (TFPR) we have regressed the log of TFPQ relative to the industry mean and the log of TFPR relative to the industry mean on the log of $P_{si}Y_{si}$ which represents value added per firm. The results are shown in the table below for the years 1990, 1995 and 2000, to see the evolution of the elasticities during the three periods of reforms.

Table 22: Elasticicites of TFPQ and TFPR with Output

	TFPQ		
Year	**1990**	**1995**	**2000**
logPsiYsi	0.3360***	0.2629***	0.3370***
	[0.0531]	[0.0717]	[0.0633]
Constant	-5.5392***	-4.6759***	-6.0552***
	[0.6377]	[1.0000]	[0.9598]
Observations	489	446	325
R-squared	0.246	0.211	0.311
	TFPR		
logPsiYsi	0.0698***	0.0339	0.0694***
	[0.0218]	[0.0233]	[0.0258]
Constant	-0.9681***	-0.4557	-1.0838**
	[0.3323]	[0.3432]	[0.4703]
Observations	489	446	325
R-squared	0.025	0.008	0.027

Source: Author's calculations

See that all the elasticities are positive and significative at the 1 percent level. In the years of the 2nd Generation Reforms (1994-1997) only the elasticity of TFPR with output in year 1994 is significative and has a value of 0.0897. In contrast, in the Post Reforms period (1998-2001) only in year 1998 the same elasticity is not significative at any level of significance. The elasticity of TFPQ with output has been stable during the whole period with an average value of 0.32.

VI. Conclusions

A long stream of papers has stressed that misallocation of inputs across firms can reduce aggregate productivity in a country. In this paper, we used micro data on manufacturing firms to analyze the possible role of such misallocation in Bolivia during the denominated "market liberalization" period (1988-2001). There is also ample literature that estimates total factor productivity (TFP) and where productivity measures are revenue-based and so they are not

necessarily good proxies for firm performance. With this caveat in mind, we have computed TFP and analyzed level, growth and dispersion of productivity breaking down this measure of productivity in revenue productivity (TFPR) and physical productivity (TFPQ).

Using the data from the Bolivian Annual Manufacturing Survey we computed these two productivity measures, and also the product and capital distortions that explain resource misallocation. We applied the same standard monopolistic competition model developed by Hsieh and Klenow (2008). One of the main conclusions is that TFP decreased steadily during the period 1988 – 2001. TFP growth decreased in -9.3 percent from which 4 percent can be attributed to a worst allocation of resources. The new development model introduced by the NPE, based in the market forces, did not permit a better allocation of resources that could boost productivity in the manufacturing industry, although it allowed increasing exports.

By performing the same "liberalization" experiments as Hsieh and Klenow (2008), that is by removing all distortions, we found that TFP would have risen by 56.2 percent during the 1st Generation Reforms period, by 60.6 percent during the 2nd Generations Reform period and by 62.6 percent during the Post reforms period. In fact, in terms of allocative inefficiency Bolivia is situated between the U.S. and China and India. Nevertheless, allocative efficiency in Bolivia declined in about -5 percent during the period of study. TFP gains relative to the U.S. increased from 6.7 percent in 1988 to 12.4 percent in 2001.

We have analyzed also some particular features of the Bolivian manufacturing sector, concentrating in the relation between TFPQ and TFPR. The first conclusion from a regression on multiple covariates is that the main characteristic that explains productivity differences in Bolivia is the size of the firm. Large firms are clearly more productive in terms of TFP than other sized firms. Additionally, productivity differences are sizable and became larger in each of the periods of reforms considered. Large firms had 177 percent higher TFPQ than micro firms during the 1st Generation Reforms period and this percentage increased up to 260 percent during the Post reforms period. Other characteristics as age, geographical location or exporting condition do not seem to influence TFPQ, although in the regressions considering only the relation between TFPQ and exporting firms we found that exporting firms were more productive than non-exporting firms, but this advantage decreased during time.

The second conclusion is that distortions measured by TFPR are independent of any of the firms' characteristics. Moreover we found that the market liberalization period and its

reforms homogenized distortions for all kind of firms, probably by promoting informality and labor flexibility. Certainly the government and policy distortions of the 80s, a result of the State involvement in production activities were removed with the market liberalization reforms, but market distortions prevailed and became equal across firms.

We found also that there is a positive and high correlation between output variation and changes in productivity. In fact the elasticity of TFPQ with output is statistically significative and in the order of 0.32 on average for the whole period. Output variation is also correlated with changes in the level of distortions but not as much as with changes in productivity per se. Finally, we identified a positive but low correlation between employment and productivity which indicates that increases in employment are associated with increases in productivity but not in a proportion that could absorb an important amount of employment.

In sum, the main success of the market liberalization period has been to assign the market a fundamental economic role, whose benefits were translated into macroeconomic stability, greater transparency for the economic relations and the boost of exports. Certainly, an important issue is why the effects of these reforms and the reforms per se have not been sustainable along time. As De Gregorio (2008) states, two issues are key for sustainable growth and productivity: i) Safe property rights and ii) Adequate structure of remunerations. In other words, this means strong institutions. The market liberalization period in Bolivia eliminated policy distortions and homogenized market distortions, but governments did not create the institutions that could sustain this process. As a reflection, we have a fully liberalized manufacturing sector, but with most of firms working under informality or pseudo formality.

Additionally, even if distortions were removed we see that there are structural problems in the manufacturing sector that impedes the increase in productivity. In fact, we found that TFP declined steadily during the market liberalization period, actual and potential TFP. In further research it would be ideal to do a more in depth analysis of the sectors, and so to infer not only the distortions that are behind resource misallocation but also the institutional problems that each sector confronts. With these elements probably we would be able to solve the puzzle of why all the reforms performed in the 90s did not translate into a sustained growth.

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Appendix

Appendix 1: The Hsieh and Klenow Model: Distortions and Productivity with Monopolistic Competition

This appendix reviews the algebra for the Hsieh and Klenow (2008) model of monopolistic competition with heterogeneous firms.

Consider an economy, where a representative firm produces the single final good Y. Output and factor markets are perfectly competitive and the firm combines the output Y_s of S manufacturing industries using the following Cobb-Douglas production function:

$$Y = \prod_{s=1}^{S} Y_s^{\theta_s} \text{ where } \sum_{s=1}^{S} \theta_s = 1 \quad \text{(A.1)}$$

By minimizing costs we obtain:

$$P_s Y_s = \theta_s PY \quad \text{(A.2)}$$

where Ps refers to the price of industry aggregate output Y_S and $P = \prod_{s=1}^{S} \left(\frac{P_s}{\theta_s} \right)^{\theta_s}$ represents the price of the final good. We assume the final output good as the numeraire, so P=1.

Aggregate industry output Y_s is itself a CES aggregate of M_s differentiated products:

$$Y = \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad \text{(A.3)}$$

Each differentiated product is produced according to a typical Cobb-Douglas production function, using capital and labor, and combining them with Total Factor Productivity (TFP)

$$Y_{si} = A_{si} K_{si}^{\alpha_s} (wL_{si})^{1-\alpha_s} \quad \text{(A.4)}$$

where Capital and labor shares are fixed within an industry, but are different between industries.

Firm profits are given by

$$\pi_{si} = (1-\tau_{Ysi}) P_{si} Y_{si} - wL_{si} - (1+\tau_{Ksi}) RK_{si} \quad \text{(A.5)}$$

where w represents the wage rate, R is the rental price of capital, τ_K is a distortion (tax) that increases the marginal product of capital relative to labor, which we call a capital distortion and τ_Y is the distortion (tax) that raises the marginal products of capital and labor by the same proportion and we call it the output distortion.

By maximizing profits, we obtain the demands of capital and labor of each firm:

$$K_{si} = \left(\frac{\sigma-1}{\sigma} \right) \frac{(1-\tau_{Ysi}) \alpha_s P_{si} Y_{si}}{(1+\tau_{Ksi}) R} \quad \text{(A.6)}$$

$$L_{si} = \left(\frac{\sigma-1}{\sigma} \right) \frac{(1-\tau_{Ysi})(1-\alpha_s) P_{si} Y_{si}}{w} \quad \text{(A.7)}$$

Replacing these demands in the production function yields an expression for the firm's output price. Notice that it is a fixed mark-up over its marginal costs.

$$P_{si} = \frac{\sigma}{\sigma - 1}\left(\frac{w}{1-\alpha_s}\right)^{1-\alpha_s}\left(\frac{R}{\alpha_s}\right)^{\alpha_s}\frac{(1+\tau_{Ksi})^{\alpha_s}}{A_{si}(1-\tau_{Ysi})} \quad \text{(A.8)}$$

Equations (A.6) and (A.7) imply also

$$\frac{K_{si}}{L_{si}} = \frac{\alpha_s}{1-\alpha_s}\cdot\frac{w}{R}\cdot\frac{1}{(1+\tau_{Ksi})} \quad \text{(A.9)}$$

the allocation of labor

$$L_{si} = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{1-\alpha_s}{w}\right)^{\sigma(1-\alpha_s)}\left(\frac{\alpha_s}{R}\right)^{\sigma\alpha_s}P_s^{\sigma}Y_s\left(\frac{1-\alpha_s}{\alpha_s}\right)^{\alpha_s}\left(\frac{R}{w}\right)^{\alpha_s}\frac{A_{si}^{\sigma-1}(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s(\sigma-1)}} \quad \text{(A.10)}$$

and the firm's output

$$Y_{si} = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{1-\alpha_s}{w}\right)^{\sigma(1-\alpha_s)}\left(\frac{\alpha_s}{R}\right)^{\sigma\alpha_s}P_s^{\sigma}Y_s\frac{A_{si}^{\sigma}(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s\sigma}} \quad \text{(A.11)}$$

It is clearly seen that the allocation of resources across firms will not only depend on firm TFP levels, but also on the output and capital wedges they face. The fact that resource allocation is driven by distortions rather than firm TFP, this will result in differences in the marginal revenue products of labor and capital across firms:

$$MRPL_i = P_{si}\left(\frac{\sigma-1}{\sigma}\right)(1-\alpha_s)\frac{Y_{si}}{L_{si}} = \frac{w}{(1-\tau_{Ysi})} \quad \text{(A.12)}$$

$$MRPK_i = P_{si}\left(\frac{\sigma-1}{\sigma}\right)\alpha_s\frac{Y_{si}}{K_{si}} = \frac{(1+\tau_{Ksi})R}{(1-\tau_{Ysi})} \quad \text{(A.13)}$$

To obtain the TFP per sector (industry), we aggregate the firm-level demands for the two factor inputs. Then, we combine the aggregate demand for the factor inputs in each sector with the allocation of total expenditure across sectors.

$$L_s = \sum_{i=1}^{M_s} L_{si} = L\frac{(1-\alpha_s)\theta_s(1-\bar{\tau}_{Ys})}{\sum_{s'=1}^{S}(1-\alpha_{s'})\theta_{s'}(1-\bar{\tau}_{Ys'})} \quad \text{(A.14)}$$

$$K_s = \sum_{i=1}^{M_s} K_{si} = K\frac{\alpha_s\theta_s\frac{1-\bar{\tau}_{Ys}}{1+\bar{\tau}_{Ks}}}{\sum_{s'=1}^{S}\alpha_{s'}\theta_{s'}\frac{1-\bar{\tau}_{Ys'}}{1+\bar{\tau}_{Ks'}}} \quad \text{(A.15)}$$

where $L = \sum_{s=1}^{S} L_s$ and $K = \sum_{s=1}^{S} K_s$ represent the aggregate supply of labor and capital, respectively, and $\bar{\tau}_{Ys} = \sum_{i=1}^{M_s}\tau_{Ysi}\left(\frac{P_{si}Y_{si}}{P_sY_s}\right)$ and $\bar{\tau}_{Ks} = \sum_{i=1}^{M_s}\tau_{Ksi}\left(\frac{K_{si}}{K_s}\right)$ denote the weighted average output and capital distortions in sector *s*.

We can then express aggregate output as a function of K_s, L_s and aggregate TFP in a sector.

$$Y = \prod_{s=1}^{S} (TFP_s \cdot K_s^{\alpha_s} \cdot L_s^{1-\alpha_s})^{\theta_s} \quad \text{(A.16)}$$

where aggregate TFP in sector s is given by:

$$TFP_s = \left\{ \sum_{i=1}^{M_s} \left[A_{si} \left(\frac{1-\tau_{Ysi}}{1-\bar{\tau}_{Ys}} \right) \left(\frac{1+\tau_{Ksi}}{1+\bar{\tau}_{Ks}} \right)^{-\alpha_s} \right]^{\sigma-1} \right\}^{\frac{1}{\sigma-1}} \quad \text{(A.17)}$$

Notice that TFP in sector s is a weighted average of A_{si}, where the weights are the firm-specific capital and output distortions.

Foster, Haltiwanger and Syverson (2008) stress that, when industry deflators are used, differences in plant-specific prices show up in the customary measure of plant TFP. Therefore it is important to distinguish between "physical productivity" (TFPQ,) and "revenue productivity" (TFPR). In other words:

$$TFPQ_{si} \equiv A_{si} \equiv \frac{Y_{si}}{K_{si}^{\alpha_s} (wL_{si})^{1-\alpha_s}} \quad \text{(A.18)}$$

$$TFPR_{si} \equiv P_{si} A_{si} \equiv \frac{P_{si} Y_{si}}{K_{si}^{\alpha_s} (wL_{si})^{1-\alpha_s}} \propto \frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}} \quad \text{(A.19)}^{20}$$

Using equations (A.12) and (A.13) we can express also TFPR per firm as a weighted average of the plant's marginal product of capital and labor:

$$TFPR_{si} = \left(\frac{MRPL_i}{w} \right)^{1-\alpha_s} \left(\frac{MRPK_i}{R} \right)^{\alpha_s} \quad \text{(A.20)}$$

From equation (A.19) it can be seen that TFPR is closely related to the proportion of capital and output wedges, in other words TFPR is also a measure of the level of distortions that each firm confronts. More clearly:

$$\frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}} = \frac{\sigma-1}{\sigma} \left(\frac{1-\alpha_s}{w} \right)^{1-\alpha_s} \left(\frac{\alpha_s}{R} \right)^{\alpha_s} TFPR_{si} \quad \text{(A.21)}$$

Using equation (A.21) in equation (A.17) yields:

$$TFP_s = \left\{ \sum_{i=1}^{M_s} \left(A_{si} \cdot \frac{\overline{TFPR}_s}{TFPR_{si}} \right)^{\sigma-1} \right\}^{\frac{1}{\sigma-1}} \quad \text{(A.22)}$$

where:

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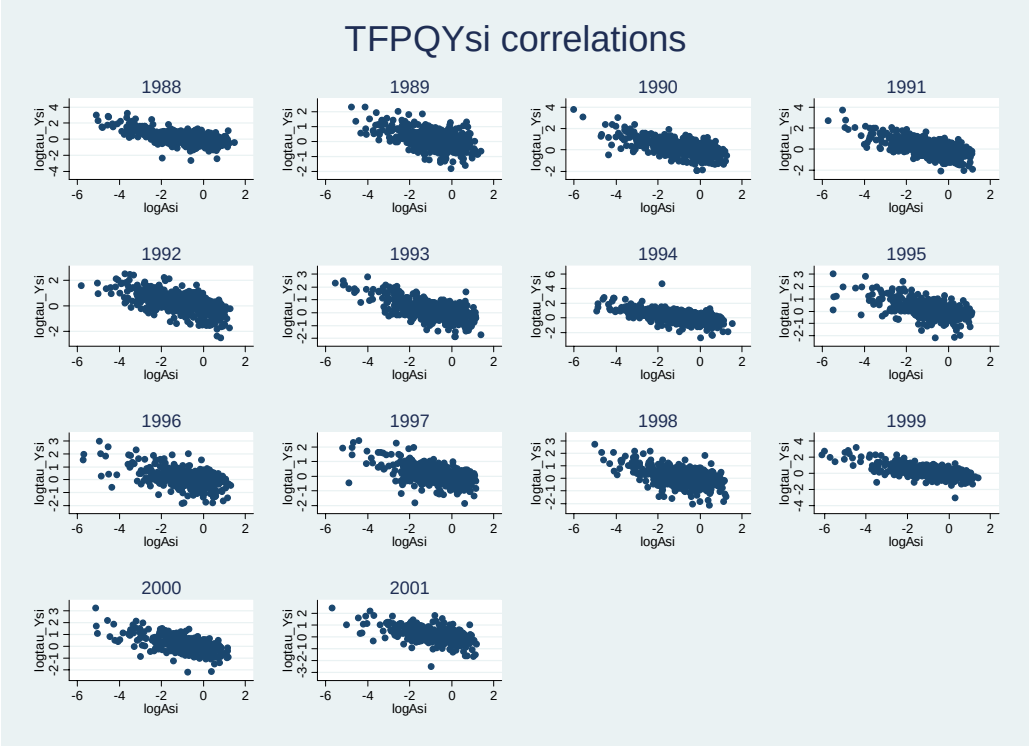
[20] In the paper we use $TFPR_{si} = \left(\frac{w}{1-\alpha_s} \right)^{1-\alpha_s} \left(\frac{R}{\alpha_s} \right)^{\alpha_s} \frac{\sigma}{\sigma-1} \frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}}$ assuming w=1.

$$\overline{TFPR}_s = \left[\frac{R}{\alpha_s}\sum_{i=1}^{M_s}\left(\frac{1+\tau_{Ksi}}{1-\tau_{Ysi}}\right)\left(\frac{P_{si}Y_{si}}{P_sY_s}\right)\right]^{\alpha_s}\left[\frac{1}{1-\alpha_s}\sum_{i=1}^{M_s}\left(\frac{1}{1-\tau_{Ysi}}\right)\left(\frac{P_{si}Y_{si}}{P_sY_s}\right)\right]^{1-\alpha_s} \quad \text{(A.23)}$$

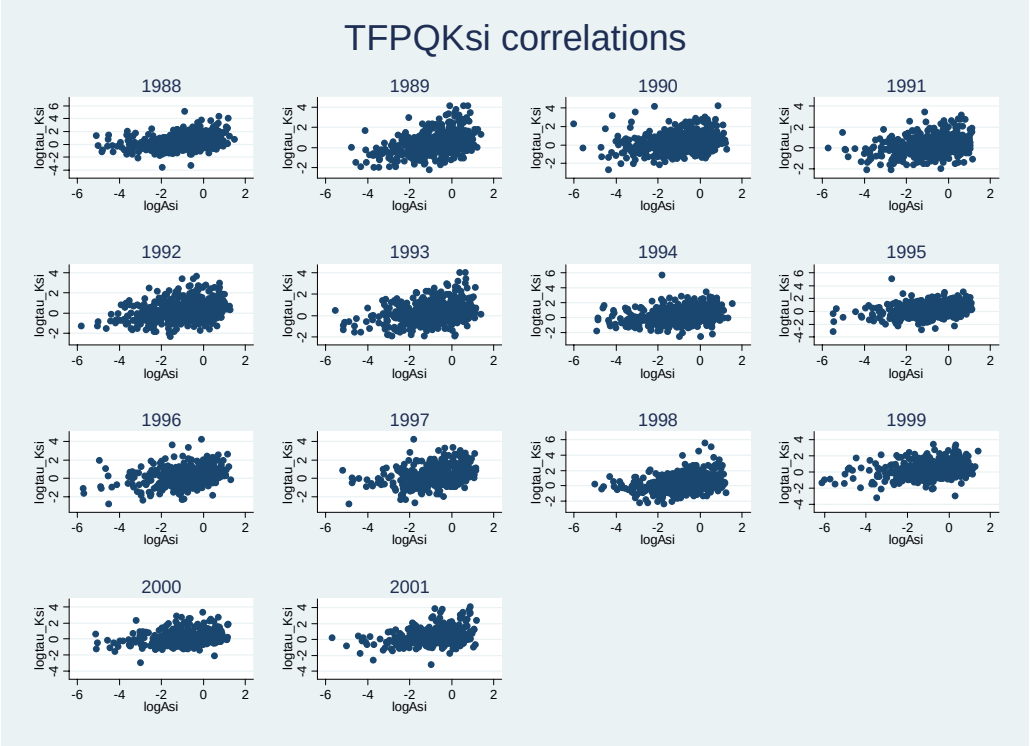
Appendix 2: Correlation between Wedges and Productivity in Bolivia

Figure A 1: TFPQ and Output Distortion Correlation



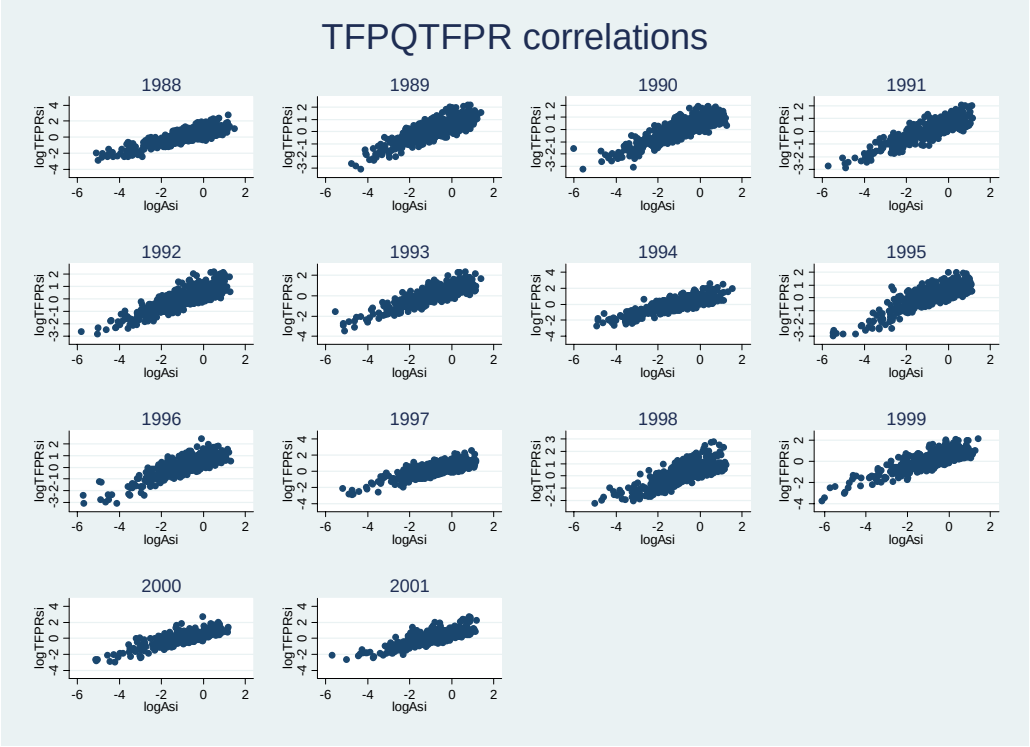
Source: Author's calculations

Figure A 2: TFPQ and Capital Distortion Correlation



Source: Author's calculations

Figure A 3: TFPQ and TFPR Correlation



Source: Author's calculations

Appendix 3: Robustness Checks

In this appendix we analyze the previous results by performing some sensitivity exercises. In particular we check if our results from the "liberalization exercise" change when we modify the parameter values used in our calculations.

Table A 1: TFP Gains of Equalizing TFPR (in percentages)

	Gains				
Year	10+ employees sigma=3 US Labor Shares Bol. Output Shares	1+ employees sigma=3 US Labor Shares Bol. Output Shares	10+ employees sigma=5 US Labor Shares Bol. Output Shares	10+ employees sigma=3 Bol. Labor shares Bol. Output Shares	10+ employees sigma=3 US Labor Shares US output shares
1988	52.50	53.77	98.58	55.38	43.02
1989	55.85	57.04	98.88	52.93	53.35
1990	56.74	58.85	99.87	56.00	46.37
1991	55.45	56.16	94.64	55.45	56.66
1992	59.69	62.01	105.96	57.38	53.19
1993	57.05	59.16	103.28	55.11	48.17
1994	62.38	61.33	112.59	59.50	58.95
1995	53.52	54.19	90.91	53.72	50.70
1996	60.86	62.94	114.27	55.93	47.26
1997	65.51	66.59	119.55	55.14	43.66
1998	70.65	72.40	121.17	67.50	49.20
1999	59.23	61.04	97.20	54.19	45.84
2000	59.86	60.40	100.84	58.12	48.94
2001	60.64	60.69	99.79	48.62	47.83

Source: Author's calculations

The Bolivian gains are indeed sensitive to the elasticity of substitution (σ). The gains with σ=5 are 1.75 times higher, on average.